Republic of Kenya

EDICT OF GOVERNMENT

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Code of practice — Installation of telecommunication cables —

Part 1: Fibre optic cable in buildings

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Kenya Broadcasting Corporation
Meteorological Department
Kenya Power & Lighting Company
Telea (K) Limited
SR Kenya Limited
Department of Defence
Kenya Police Force
Communications Commission of Kenya
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In order to keep abreast of progress in industry, Kenya standards shall be regularly reviewed. Suggestions for improvement to published standards, addressed to the Managing Director, Kenya Bureau of Standards, are welcome.

Code of practice — Installation of telecommunication cables —

Part 1: Fibre optic cable in buildings

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FOREWORD

This Kenya standard was prepared by the *Communication Equipment* under the mandate of the Electrical Industry Standards Committee in accordance with the procedures of the Bureau and is in compliance with Annex 3 of the WTO/TB Agreement.

This Kenya Standard specifies installation practices for fibre optic cables in commercial premises, including single or multiple buildings in a campus environment.

The guidelines provided in this standard are intended as a reference both for installers of high performance communications cables and for their customers, and are aimed at achieving proper installation of such cabling systems. Failure to comply with the installation practices described in this Kenya Standard might severely degrade the performance of the cabling.

Normative and informative annexes

A 'normative' annex is an integral part of a standard, whereas an 'informative' annex is only for information and guidance.

Summary of development

This Kenya Standard, having been prepared by the Communication Equipment Technical Committee was first approved by the National Standards Council in December 2008	**Amendments issued since publication**		
	Amd. No.	Date	Text affected

Code of practice — Installation of telecommunication cables — Part 1: Fibre optic cable in buildings

1 Scope

1.1 This part of this Kenya Standard addresses installation requirements, primarily for indoor cabling, but also for campus-wide inter-building cabling, for high performance fibre optic cable that serves to transmit voice, video and data telecommunication.

1.2 This Kenya Standard emphasizes optimal link performance through the proper planning, design, installation and quality testing of the cables, and strict adherence to the guidelines given in this Kenya Standard to avoid possible compromising of the integrity and performance of the installation.

2 Normative references

The following referenced documents are indispensable for the application of this standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

KS ISO IEC 11801, *Information technology — Generic cabling for customer premises*

3 Definitions and abbreviations

For the purposes of this standard, the following definitions and abbreviations apply:

3.1 Definitions

3.1.1
application
a system, with its associated transmission method, that is supported by telecommunication cabling

3.1.2
backbone cabling
the vertical or riser cabling of a multi-storey building or inter-building cabling on a multi-building site, owned by the telecommunication carrier or any other party, which forms the permanent reticulation of that building or site and which is generally accessible for future additions or alterations

3.1.3
bonding
the permanent joining of metallic parts to form an electrically conductive path that will assure electrical continuity

3.1.4
cabinet
a container that can enclose connection devices, terminations, apparatus, wiring and equipment, including active electronic equipment

3.1.5
cable
an assembly of one or more cable units of the same type and category in an overall sheath

3.1.6
cable element
the smallest construction unit (for example a pair, a quad or a single fibre) in a cable

NOTE The cable element can have a shield.

3.1.7
cable unit
a single assembly of one or more cable elements of the same type or category

NOTE The cable unit can have a shield.

3.1.8
cabling
physical media for conducting signals

3.1.9
campus
premises that contain one or more buildings

3.1.10
channel
the end-to-end transmission path that connects two pieces of application-specific equipment, including equipment and work area cables

NOTE A channel occurs, for example, between the end of the patch cord on the patch panel in the equipment room and the end of the fly-lead that connects it to the connection terminal equipment.

3.1.11
commercial building
a building, or part thereof, that is intended for office use

3.1.12
customer
a person who contracts with a telecommunication carrier or service provider to supply a telecommunication service

3.1.13
distributor
an assembly of components and equipment, for example a patch panel (see 3.1.24) and patch cords (see 3.1.23), used to connect cables

3.1.14
fibre optic cable
optic cable
a cable that comprises one or more fibre optic cable elements

3.1.15
floor distributor
the distributor (see 3.1.13) used to connect the horizontal cable and other cabling subsystems or equipment (see also 3.1.27)

3.1.16
frame
any assembly of cabling hardware that provides for the termination and the cross-connection of cabling by means of jumpers (see 3.1.21) or patch cords (see 3.1.23)

NOTE The international term is distributor.

3.1.17
generic cabling
a structured telecommunication cabling system that is capable of supporting a wide range of applications

NOTE 1 Generic cabling can be installed without prior knowledge of the required applications.

NOTE 2 Application-specific hardware does not form part of generic cabling.

3.1.18
grounding
earthing
a conducting connection, whether intentional or accidental, between an electrical circuit or equipment and the earth, or to a conducting body that can serve as an earth

3.1.19
hardware
devices used to connect cable (or wires) to facilitate cross-connection or extension to another cable or other equipment

3.1.20
horizontal cabling
the cable reticulation that serves a particular floor of a building, in order words, that extends from (and includes) the telecommunication outlet connector at the work area to the horizontal cross-connection in the telecommunication closet (see 3.1.27)

3.1.21
jumper
a cable unit or cable element without connectors, used to make an interconnection or a cross-connection

3.1.22
link
the transmission path between any two interfaces of generic cabling (see 3.1.17)

NOTE The link does not include equipment and work area cables.

3.1.23
patch cord
a flexible cable unit or element with one or more connectors, used to establish connections on a patch panel

3.1.24
patch panel
a facility that enables the termination of cables or cable units and also their interconnection, or cross-connection (or both), primarily by means of a patch cord (see 3.1.23) or jumper (see 3.1.21)

NOTE This facility is also known as an optic distribution frame (ODF).

3.1.25
service provider
the organization(s) responsible for providing public network services

3.1.26
sheath
the outer protective layer of a cable

3.1.27
telecommunication closet
an enclosed space for housing telecommunication equipment, cable terminations and cross-connection cabling

NOTE The telecommunication closet is a recognized cross-connection point between the backbone (see 3.1.2) and the horizontal (see 3.1.20) cabling subsystems.

3.1.28
telecommunication infrastructure
the components, namely telecommunication equipment spaces, cable pathways, grounding (see 3.1.18), wiring and termination hardware that, together, provide the basic support for the distribution of all telecommunication information

3.1.29
telecommunications

the branch of technology that is concerned with the transmission, emission and reception of signs, signals, writing, images and sounds, in other words, information of any nature, by cable, radio, optic or other electromagnetic systems

3.1.30
topology
the physical or logical configuration of a telecommunication system, for example, star, bus or ring

3.1.31
wiring
the single-pair, two-pair, three-pair or four-pair cable used between a cable terminal and an individual user's telecommunication outlet

3.1.32
work area
a building space where the occupants interact with telecommunication equipment

3.2 Abbreviations

HVAC heating, ventilation and air conditioning

IEC International Electrotechnical Commission

ISO International Organization for Standardization

PVC polyvinyl chloride

4 Planning

4.1 The proper installation of communication cables calls for thorough planning before installation starts. Time spent planning the routes before starting installation can save many hours of frustrating rerouting and recabling. It can also mean the difference between a system that works and one that does not work.

4.2 Issues to consider when planning an installation include

a) establishing the specific requirements and services relevant to the customer's proposed installation and terminal equipment,

b) establishing the existence of a cable network infrastructure,

c) the accessibility of the cable network system,

d) assessing the current and future requirements for a cabling infrastructure,

e) identifying and noting the position of other utility services, including plumbing, electrical cables and heating, ventilation and air conditioning (HVAC) services, and

f) identifying the desirability of using flame-proof or flame-retardant cable in the proposed installation.

4.3 It is highly recommended that electrical layout plans, or floor layout plans (or both) be obtained before the communication cabling infrastructure for a building is designed. The plans will indicate the location, type and extent of the cable support infrastructure in the form of conduits, inspection boxes and cable trays. The plans should also indicate if the support systems are intended for the exclusive use of a particular reticulation system, or if they can be used for a variety of services. Support systems that are intended for other services shall not be used for the installation of the fibre optic service.

4.4 In the absence of drawings, a physical inspection of the facilities should be done and the size and location of cable support structures and their accessibility noted. The capacity of the conduits, trunking or tray intended to be used shall be visually inspected. The support channel shall not be overfilled. Instead, the possibility of removing redundant cables before installing new ones shall be investigated. Should this still not have the desired result, a new route shall be installed.

4.5 Future expansion shall be allowed for when planning for, or using, cable support structures. Although no strict rules exist as to the capacity fill of a channel, future requirements and upgrades shall be kept in mind. A general rule is that an open channel or cable tray may not be filled to more than 50 % of its total capacity upon initial installation. For conduits and pipes the maximum fill capacity should not exceed 33 %. When the open channel reaches 75 % of total capacity fill, a new route should be planned. The planning for a new route allows for the future addition of cables required for the purpose of expansion or for new applications.

4.6 When planning the routes for the support infrastructure, it shall be borne in mind that the horizontal cables are laid out in a star topology, in other words, the cables that terminate at the work area are fed from a central point, namely the floor distributor. In larger installations, this could take the form of a hierarchical star topology, using a building distributor to feed several floor distributors, again using a star topology. (See KS ISO IEC 11801.)

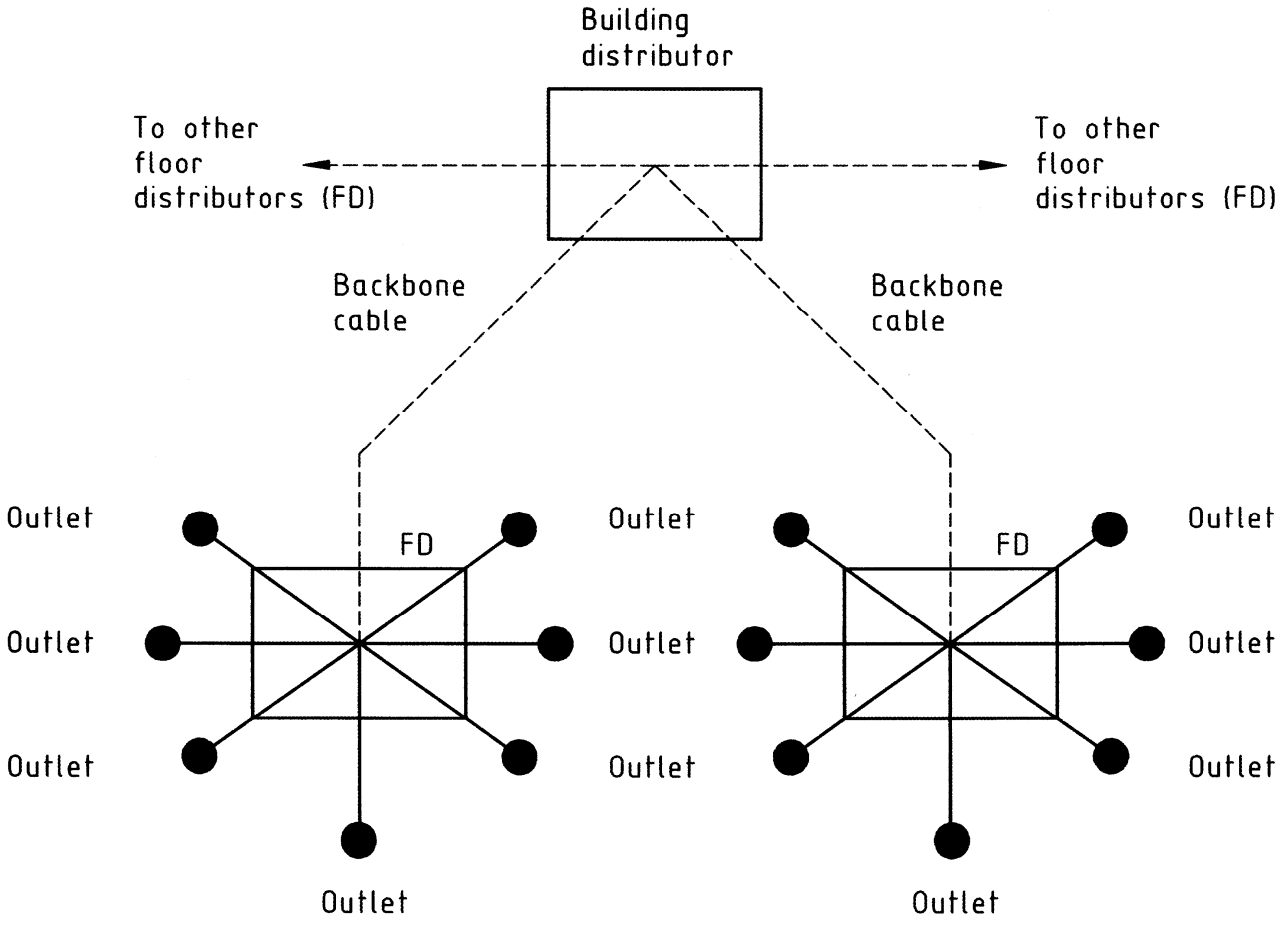

Figure 1 — Hierarchical star topology

4.7 Under normal circumstances the maximum distance of fibre optic cable shall be in accordance with KS ISO IEC 11801.

4.8 A telecommunication closet (see 3.1.27), normally a 480 mm equipment cabinet, shall be used to house the termination of the horizontal cable. Possible future additions shall also be considered.

4.9 Equipment cabinets can be of either the floor-standing or the wall-mounted type. In either case, the position of the cabinet shall be permanent. In a clean, protected environment, an open equipment frame may be used instead of a cabinet.

4.10 The location of any firewalls that might obstruct the path of the planned route shall be noted. If no provision has been made for cable routes through firewalls, the architect or engineer should be consulted. Under no circumstances shall the integrity of firewalls be violated by drilling or breaking holes through them unless provision has been made for the reinstatement of their integrity.

4.11 When sealing the spaces around cables or support structures that penetrate a firewall, only approved building materials shall be used. Many types of expandable foam that are popular among installers for repairing large holes in walls are highly flammable and shall not be used.

5 Trunking and conduits

5.1 Trunking

Before the installation of trunking and conduits, special care should be taken to adhere to cable specifications with regard to bending radii. It is important to adhere to the 33 % maximum fill ratio for conduits and closed trunking and the 50 % maximum fill ratio for open trays.

5.2 Conduits

5.2.1 All exposed cabling should be housed in rigid metal or PVC conduits and flexible PVC tubing for additional protection. The use of PVC products should be avoided where low halogen levels, a zero halogen level or fire retardant properties are required.

5.2.2 No single, uninterrupted section of conduit should extend for more than 30 m. In addition, no segment shall contain more than two 90° bends between the two ends or between any two pull boxes.

5.2.3 The radius of a bend should be at least six times the inside diameter of the conduit for conduits of diameter exceeding 50 mm. For conduits of diameter 50 mm or less, the bend radius should be ten times the inside diameter of the conduit.

5.2.4 The minimum bend radius to be installed in the conduit should be taken into account and should be the larger of the conduit bend radius (see 5.2.3) and the cable bend radius (see 6.3).

6 Preparation

6.1 Proper performance will only be achieved with careful installation of the cable and adequate support of the installed cable. It is therefore imperative that the cabling routes be properly planned and supported. The preparation of the cable installation includes the preparation of the cable routes and the cable support structure.

6.2 The installer shall establish that the pathways defined in the installation specification are accessible and available in accordance with the installation programme and that all routes are open and free of any obstruction. Ceiling tiles, skirting covers and any access apertures shall be opened up at convenient locations and where there is a change in direction of the route. The customer shall be advised of all proposed deviations.

6.3 The installer shall ensure that the routes are open and sufficiently accessible to allow for the cable to be pulled without exceeding the maximum pulling limit. The installer shall ensure that the bend radii of the routes are checked to be smooth and gradual. The cable shall not be pulled around too many bends or sharp corners and the pulling route shall be so planned that the pulls are as straight as possible. Under no circumstances shall the cable be allowed to be bent at a radius less than the minimum bend radius. As a rule of thumb the minimum bend radius is at least twenty times the diameter of the cable in the case of concentric fibre optic cables. Ruggedized indoor fibre cables are more flexible and could have a smaller bend radius.

6.4 The installer shall establish that the environmental conditions within the pathways and the installation methods to be used are suitable for the design of the cable to be installed. Since moisture affects cable performance, places that are damp or where liquids can accumulate should be avoided as far as possible.

6.5 Other environmental factors shall also be considered. Cables shall not be installed in areas of extreme temperatures. The installer shall ensure that the cable is rated for the expected temperature range by confirming the cable specifications with the supplier or the manufacturer.

6.6 Cabling routes should be kept clear of metal roofs, steam pipes, ovens and other sources of heat, such as the outsides of refrigeration plants.

6.7 All types of cable require some form of support. The cable supports should be spaced not more than 1,5m apart and cable sag between supports shall not exceed 30mm. The cable supports shall have no sharp

edges that can damage the cable. The contact area of the support should have a contact surface that is larger than the minimum bend radius of the cable.

6.8 When installing cabling above suspended ceilings, the cable should be supported from the roof or a wall. Cables shall not be laid direct on top of ceiling tiles or be tied to the ceiling support wires or metal straps.

6.9 The installer shall establish that the existing pathways are capable of supporting the full weight of the cables to be installed. If new supports are being installed, only materials rated for the application shall be used.

6.10 It is essential that pathways are left clean and free from obstruction with all separators and bridging pieces in place before installation. Access points shall not be obstructed.

6.11 The installer shall establish the proposed storage locations for all cabling components and accessories and shall ensure that the environmental conditions in those locations are suitable and that appropriate security is available. The installer shall ensure that fibre cables are pretested to confirm their continuity and length. Following testing, the ends of stored cables shall be sealed. Any attached certificate or test records related to the quality and quantity of the cable contained on the reel shall be retained and compared to the pretest results.

6.12 The installer shall determine the proposed locations at which cable drums will be positioned during the installation programme, establish the accessibility and availability of those locations and ensure that all the necessary installation accessories and equipment are available.

6.13 The installer shall label the physical positions of all the points and cabinets with temporary labels after consultation with the client and shall update the plan accordingly. If no plan is available, the installer shall make a rough sketch to indicate all the offices and the locations of the cabling system terminations, and also how the installation shall be numbered. If this is not prescribed by the client, the installer shall plan a logical labelling system, label all housings and update the plan accordingly.

6.14 The installer shall plan each cable route and shall decide how the cables shall be pulled to the destination points and from which direction the pulling shall be facilitated. It might be better to pull from the cabinet or from some common point along the route towards the work area. Alternatively, circumstances might require the pulling of the cable from the work area towards the cabinet. In some cases it might be possible to measure and cut the cables before installation and then to pull bundles of cables rather than single cables.

6.15 It is important that these plans be communicated to all members of the installation team to avoid any misunderstandings and resultant loss of materials or productivity (or both).

6.16 Label the cables with the same number on each end using temporary, wrap-around labels that can be discarded once the cable has been permanently labelled and marked. The number on the label shall correspond with the numbering on the plan.

6.17 The installer shall check that all draw wires are intact and that they can move freely. If no draw wires are available, fish tape shall be used to pull the cables.

6.18 Safety measures to be taken include ensuring that all the necessary guards, protective structures and warning signs are available to protect the cabling equipment, cable installers and bystanders.

7 Installation

7.1 General cabling practice

7.1.1 The maximum pulling tensions as detailed in the manufacturer's specification shall not be exceeded when drawing in the cables. Cables shall be installed in accordance with the manufacturer's specification.

7.1.2 Most installation problems can be avoided by avoiding sharp corners, kinks and turns and gradually pulling manageable lengths of cable into place, without undue snatching.

7.1.3 Performance specifications for cable and connecting hardware are based on the use of proper installation practices and cable management techniques in accordance with the manufacturer's guidelines. If

the recommended precautions and installation methods are not observed, the transmission capabilities of cabling components as specified might not be achieved.

7.2 Temporary labelling

When pulling several runs of cable along a route at the same time, the loose ends of each cabling run shall be labelled with a unique identifier to aid identification of each cabling run. Cables shall always be labelled before installation. This can be done by using temporary labels that can be replaced by permanent labels during the termination process.

7.3 Protection of installed cables

Restraining clips or ties shall be fitted, as required, to maintain the minimum bend radii for fixing. Where there is a risk of the ingress of fluids or other contaminants, exposed cable ends shall be fitted with suitable protective caps until terminated. After installation, care shall be taken to prevent installed cables from suffering excessive (steady state) strain by introducing suitable supports.

7.4 General considerations

7.4.1 To prevent damage (excess bending), no more cable should be unspooled at any one time than the length required and the cable should be drawn direct from the cable reel to avoid its getting tangled. Cable should not be unspooled sideways over the reel flange. If the cable is removed from the cable reel, it should be coiled in a figure-of-eight pattern to prevent tangling and longitudinal twists.

7.4.2 When using cut lengths the installer shall ensure that suitable excess length is provided to take into account any bends in the pathway.

7.4.3 When pulling cables around tight bends, damage to the outer sheath through pulling stress, friction and strain should be avoided. Cable guides or additional personnel should be used to assist with cable pulling at these points.

7.5 Underfloor installation of cables

7.5.1 When installing cabling runs in underfloor systems (raised or computer flooring), the cable should be installed in either an open tray or in closed metal trunking. Ideally, cable routes should follow a path parallel to the building's walls. Cable routes shall not be diagonal to the building's walls.

7.5.2 Before drawing in new cable the installer shall ensure that the draw wire is free to move and is not entangled with existing cables.

7.5.3 The draw wire should be securely fixed to the sheath or strain relief element of the cable in accordance with the manufacturer's recommended method. Under no circumstances shall the draw wire be attached to the fibres of the cable.

7.5.4 Cables should always be pulled slowly and smoothly, and the maximum pulling stress of the cable shall not be exceeded as this might damage the protective sheath of the cable or the fibres inside the sheath.

7.5.5 When installing cables in trays for horizontal or vertical runs, the cables shall be secured with cable strap ties at appropriate distances. Care shall be taken not to overtighten cable strap ties.

7.6 Installation of cables in wall trunking

7.6.1 Cable routing through visible trunking systems should not only satisfy the functional requirements; the overall aesthetic concept of the building or the environment should not be overlooked.

7.6.2 All the safety requirements with regard to the separation of mains electricity cables and fibre optic cables shall be satisfied.

7.6.3 The installation process shall not degrade the intended environmental performance, for example, appropriate seals shall be fitted and fire barriers shall comply with the building requirements. Metallic trunking installation systems and accessories shall be included in the protection measures against electric

shock hazard through proper grounding and bonding. Live wires shall be not accessible after removing the wall trunking cover.

7.6.4 Cables shall be so installed as to allow for the future installation of additional cables without damage to either the old or the new cables.

7.7 Installation of cables in ceiling voids

7.7.1 Particular care should be taken when installing cables in ceiling voids. Cables shall not be installed in ventilation ducts. Cables shall not lie direct on ceiling tiles or fluorescent light boxes.

7.7.2 Proper support shall be provided. If cable trays or closed metal trunking cannot be used, support brackets may be used, but these shall be spaced not more than 1.5 m apart to minimize cable sag. Cable sag shall not exceed 30 mm between fasteners.

7.7.3 Conduits may be installed in the ceiling void, but inspection boxes shall be provided at regular intervals.

7.7.4 Cables shall not be tied to the ceiling suspension wires. The cable ties used to bundle the cables shall not be overtightened; the purpose of the cable ties is to keep the cables in a neat bundle. Overtightening can lead to distortion of the cable's physical parameters and a decline in performance.

7.7.5 High-temperature areas shall be avoided and as much clearance from metal roofs as possible shall be maintained.

7.7.6 The installer shall not leave excessive service loops or slack in the ceiling since these are difficult to manage and can lead to errors when using optic test equipment to locate the distance to a fault. Care shall be taken to leave only enough slack to allow for future maintenance purposes.

7.8 Vertical cabling (backbone cabling)

7.8.1 When installing cabling runs in vertical risers, lowering the cable is preferable to pulling it up the rise. This practice is referred to as the top-down method of installation.

7.8.2 When using the bottom-up method of installation where cables are pulled up, the cables shall be fed carefully through each floor of the building. Particular care shall be taken to ensure that the cable is not overstressed and that the cable sheath is not subject to any undue stresses owing to friction at any contact points.

7.8.3 It is recommended that a strain-relief loop or appropriate fixings be provided at every second floor to avoid excessive gravity force on the cables. Care should be taken that the radius of the strain relief loop conform to the manufacturer's specified bend radius.

7.9 Installation of cables through firewalls

When it is necessary to penetrate a firewall or protection structure, the integrity of this structure shall be restored to an acceptable level.

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IEC 60794-1-1, *Optical fibre cables — Part 1-1: Generic specification — General*